



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE

United States Patent and Trademark Office

Address: COMMISSIONER FOR PATENTS

P.O. Box 1450

Alexandria, Virginia 22303-1450

www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09 616,372	07 13 2000	Atsushi Komura	1-50	6846

23400

7590

07 08 2003

POSZ & BETHARDS, PLC
11250 ROGER BACON DRIVE
SUITE 10
RESTON, VA 20190

EXAMINER

SOUW, BERNARD E

ART UNIT

PAPER NUMBER

2881

DATE MAILED: 07 08 2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/616,372

Applicant(s)

KOMURA ET AL.

Examiner

Bernard E Souw

Art Unit

2881

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on 21 May 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☐ Claim(s) 1-3, 5-7, 9, 10, 12-14, 16-18, 20 and 21 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-3, 5-7, 9, 10, 12-14, 16-18, 20 and 21 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on 13 July 2000 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ 6) ☐ Other: _____

DETAILED ACTION

Finality of Last Office Action Withdrawn

1. Applicant's request dated 05/21/2003 (Paper No.10) for reconsideration of the finality of the rejection of the last Office Action dated 03/18/2003 (Paper No.7) is persuasive and, therefore, the finality of that action is withdrawn.

However, the Office Action itself, i.e., the rejection of the claims, both in the form of reaffirmations as well as those based on new grounds of rejection, is **NOT** withdrawn, but serves as a basis for this new Office Action. For example, the § 101 rejections here being considered is not only the § 101 rejections applied in the first Office Action dated 07/29/2002 (Paper No.4), but also including the § 101 rejections applied in the last Office Action dated 03/18/2003 (Paper No.7). In consequence, a new Final Rejection is legitimate, insofar as there is no new ground of rejection raised by the examiner beyond those already recited in the last Office Action (Paper No.7).

To this effect, Applicant has enjoyed ample opportunity to make appropriate amendments to the claims, and/or bring up arguments against the previous rejections, including those raised in the last Office Action dated 03/18/2003 (Paper No.7), and should have been forwarded at the same time (05/21/2003) as Applicant's request for finality withdrawal (Paper No.10) in anticipation of this Office Action.

2. The Supplemental Amendment B dated 03/26/2003, in response to the first Office Action mailed 08/14/2002 (Paper No.4) has been entered as Paper No.8/B on

04/09/2003, i.e., after the last Office Action dated 03/18/2003 (Paper No.7) has been mailed.

Claims 4, 11, 15 and 22 have been cancelled.

No new amendment has been made.

Pending in this Office Action are claims 1-3, 5-7, 9, 10, 12-14, 16-18, 20 and 21.

The present Office Action is made with all the suggested amendments being fully considered.

3. Since the last Office Action (Paper No.7) is **not** withdrawn, previously recited acknowledgements and objections generally will not be repeated, unless considered necessary, e.g. to obtain Applicant's special attention.

Drawings

4. The drawings are objected to because the horizontal axis in Fig.3 is still labeled "LEFT PERIOD OF TIME", although the same terminology appearing in the specification, abstract and claims, has been amended to "EXPOSURE PERIOD" per Amendment A (Paper No.6/a). Therefore, the same objection is here raised for a second time. A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Information Disclosure Statement

5. (Repeat from previous Office Action) The information disclosure statement filed 07/13/2000 fails to comply with the provisions of 37 CFR 1.97, 1.98 and MPEP § 609 because the English translation is not provided by the Applicant. It has been placed in the application file, but the information referred to therein has not been considered as to the merits. Applicant is advised that the date of any re-submission of any item of information contained in this information disclosure statement or the submission of any missing element(s) will be the date of submission for purposes of determining compliance with the requirements based on the time of filing the statement, including all certification requirements for statements under 37 CFR 1.97(e). See MPEP § 609 ¶ C(1). Again, this objection is the same as what has been raised in the last Office Action (Paper No.7).

Reinstatement of Previous Objections

6. (Repeat from previous Office Action) In the Amendment A, paper no.6/a, page 2, line 3 after Eq.(1), the wording "*The variation is calculated at 3σ* " is not used in conventionally accepted meaning in the statistics: A variation can be *determined* from results of measurements, but not *calculated*, unless the distribution function is analytically known. This is the same objection as previously raised in the first Office Action, which objection is herewith reaffirmed. Consequently, the previous objection is here reinstated.

New Objections Regarding the Amended Specification

7. (Repeat from previous Office Action) In the Amendment A, paper no.6/a, page 2, lines 9-10, in the amended sentence "*The graph of Fig.3 varies with every film, and the thickness **variation T indicates the variation in thickness that occurs***", one of ordinary skill in the art understands the wording "*variation in thickness that occurs*" being no other than the standard deviation σ . This new objection gives rise to a multiple of new objections against all parts of the specification, in which S (defined as 3 times the standard deviation, i.e., $3\cdot\sigma$) and T ($=\sigma$, or in its broadest sense, a multiple of σ according to the new amended definition, as understood by one skilled in the art) appear together, e.g., in Eq. (1), because under the new amended definition of T the equation becomes not understandable. This new objection also gives rise to a multiple of new rejections under § 112, in which the indefinite expression of Eq.(1) is recited as claim limitations (this refers to claims 4, 11, 15, 22).

In order to proceed with this Office Action, the previous position taken by the Examiner is resumed, i.e., in accordance with the previous rejections of claims 4, 11, 15 and 22 recited In the first office Action, wherein S and T are interpreted as being two statistically independent standard deviations (or multiples thereof), one (T) resulting from the process of measuring the film thickness that produces a variation in the apparent thickness the other (S) resulting from the process of forming the oxide film that produces a variation in the physical thickness.

8. (Repeat from previous Office Action) In the Amendment A, paper no.6/a, page 2, lines 1-2, in the amended wording "*an allowable thickness variation with respect to latitude (specification) for process control etc.*", due to the amended new definitions of S and T objected above, the previously vague definition of U in Eq.(1) has now become not understandable, because it loses all its possible meaning, and hence, becomes indefinite. This new objection inevitably gives rise to a multiple of new rejections under § 112, in which the indefinite expression of Eq.(1) is recited as claim limitations (this refers to claims 4, 11, 15, 22).

9. (Repeat from previous Office Action) In the Amendment A, paper no.6/a, page 3, lines 11-14, if in the formula (2) the period t is set to zero ($t=0$ in Eq.(2)), the thickness of the gate oxide, $y = y(t=0)$, is not 0 \AA as recited by Applicant, but negative infinite ($-\infty$). Applicant is violating a law of mathematics, and hence, Eq.(2) is now rejected under § 101 (inoperative) by Applicant's own amended interpretation. This is not a new objection, but a repeat of the last Office Action (Paper No.7), which also gives rise to a new § 101 rejections of all claims reciting Eq.(2) as limitations (i.e., claims 3, 10, 14, 21). Eq.2 was previously declared "indefinite" by the Examiner in the first Office Action due to a previous indefiniteness of the wording "*left period of time*". Applicant's amendment of the wording "*left period of time*" per Amendment A (paper no.6/a) has removed the previous indefiniteness, but on the other side has led to the inoperativeness of Applicant's definition, or interpretation, of Eq.(2).

10. (Repeat from previous Office Action) In the Amendment A, paper no.6/a, page 4, lines 8-9, the amended sentence “[~~change variation in~~] **variation in change of the thickness ...**” is not understandable. In order to proceed with this examination, the wording is interpreted as “*variation in **an increase** of the thickness ...*”, as is also understood by one skilled in the art.

New Claim Rejections - 35 USC § 101

11. (Repeat from previous Office Action) 35 U.S.C. 101 reads as follows:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

Claims 3, 10, 14 and 21 are rejected under 35 U.S.C. 101, because the claimed invention is inoperative. The inoperativeness is here a consequence of the claim limitation $y = a \cdot \ln(t) + b$, which, according to Applicant's definition or interpretation (Amendment A, paper no.6/a, page 3, lines 11-14), would result in $y=0$ for $t=0$. Applicant is here using a new mathematics that is fully different than what is conventionally accepted. According to conventional mathematics, $y = y(t=0)$, is not 0 \AA as recited by Applicant, but negative infinite ($-\infty$).

Correction is here required. However, Applicant is cautioned not to introduce New Matter.

To proceed with this Office Action, a formula as recited by Bozada et al. USPAT # 6,004,881, Eq. 1 in Col.6/ll.35-36, is assumed, whereby the constants are to be fitted to the results of measurement, as generally known in the art.

(NEW) Examiner's Suggestion: As generally known to one of ordinary skill in the art, a *mathematically correct* empirical formula would be, e.g., $y = a \cdot \ln(1+t) + b$, which reduces to $y=b$ for $t=0$, or even better, $y = a \cdot \ln(1+t/t_0) + b$, in view that function $\ln(x)$ must be rigorously of a dimensionless argument "x" (see a correct formulation in the newly cited Prior Art, Bozada et al. USPAT # 6,004,881, Eq. 1 in Col.6/ll.35-36, in which the unit of t is unambiguously specified). Another acceptable variant is given by Salmon et al. (Materials at High temperatures **17**(2), pg. 272, Eq. 2, adopted from earlier dated references [4] and [5]), in which the factor "**a**" assumes the dimension of $[time]^1$.

Previous 35 USC § 101 Rejections Reinstated

12. (Modified from the last Office Action, as necessitated by Applicant's Affidavit or Declaration, Paper No.9) Insofar as the Examiner can ascertain beyond the last recited rejection under 35 U.S.C. 101, i.e., by using a mathematically acceptable formula given by Bozada et al., as recited above, claims 3, 10, 14 and 21 *stand* rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter, as *already applied in the previous Office Action*.

Interpreted in light of the specification, claims 3, 10, 14 and 21 do not recite any method that can be claimed, but just an equation or formula (i.e., Eq.2, under a corrected interpretation as understood by one skilled in the art), which is not invented by Applicant but is widely known in the art in various forms of empirical formulas, as admitted by Applicant himself on pg.15/ll.17-20, and evidenced by the Examiner's

suggestion according to the level of ordinary skill in the art, further supported by Salmon et al., as recited above.

Given a behavior shown in Applicant's Fig. 3 and/or Salmon's Fig.3 on pg.273, it would have been obvious to one of ordinary skill in the art at the time the invention was made to derive an empirical formula such as one given by Bozada (Eq. 1), or suggested by the Examiner, or by Salmon et al. The behavior shown in Applicant's Fig. 3 and/or Salmon's Fig.3, approximated by whatever mathematical form, is a result of natural law, which always occurs without any active manipulation by the Applicant. As such, it belongs to non-statutory subject matter that cannot be claimed.

The above statement is an evidence for a previous Official Notice taken by the Examiner, which is here provided by a large number of prior arts, e.g., (1) Salmon et al. (PTO-892) pg.272/Col.2, Eq.(2), referring to two references (Beaunier et al., 1984, and Dorlot et al. (1986), reciting that the logarithmic law is typical for the growth of thin oxide films, and (2) Schell et al., FZR Report 05/10/1999 (PTO-892), pg.2, Fig.2 + 2 lines below Fig.2.

Previous 35 USC § 112 Rejections Reinstated

13. (Modified from the last Office Action) Claims 3, 10, 14 and 21 *stand* rejected under 35 U.S.C. 112, first paragraph, in addition to the previous rejection under 35 U.S.C. 101, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Neither the specification nor any of the claims teaches how to obtain the factor "*a*" required to calculate the real thickness according to Applicant's formula, $b = y - a \cdot \ln(t)$ where *b* is the real thickness of the oxide film, *y* the measured value of thickness, and *t* is the time of exposure to atmospheric environment. More specifically, the claim language reciting that "*a* is a **constant determined based on atmosphere around the oxide film**" does not teach any prospective user how to make and/or use Applicant's invention.

Applicant is expressly cautioned not to introduce New Matter in obviating this 35 U.S.C. 112, first paragraph rejection.

14. (Repeat of last Office Action) Claims 3, 10, 14 and 21 also *stand* rejected under 35 U.S.C. 112, second paragraph, in addition to the previous rejections under 35 U.S.C. 101 and 35 U.S.C. 112, first paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

If "*b*" is already known as the *real* thickness of the oxide film, as recited in the claim, as well as in the specification, as admitted on pg. 10 lines 3-4, and confirmed by Amendment 6/a, page 3, line 8, "*The constant *b* is a thickness of the oxide film measured immediately after the gate oxide film 8 is formed*", why would anyone spend more time and energy for measuring the parameter once again, using Applicant's suggested method and/or formula?

RESPONSE TO APPLICANT'S ARGUMENTS

15. Applicant's arguments in Paper # 8 are moot, because of new grounds for rejections necessitated by Applicant's rebuttal of the Examiner's main prior art (Huang USPAT # 6,221,790).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

16. Claims 1, 5, 12, and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bozada et al. (USPAT # 6,004,881) in view of Kobayashi et al. (USPAT # 6,221,788).

Bozada et al. discloses a method for measuring thickness of an oxide film, as recited in Col.6/30-37. Bozada's method comprises:

- forming an oxide film on a substrate, as recited in Col.6/11.18-22;
- measuring an "*exposure period of time from a time at which the thickness of the oxide film is measured*", which is inherent in Col.6/11.21-36, as represented by the parameter t in Eq.(1) recited in Col.6/11.35-36;
- measuring the thickness of the oxide film by irradiating the oxide film with light in accordance with the "*exposure period*", as recited in Col.6/11.30-33 and represented by Bozada's Eq.(1).

Although a step of washing or cleaning the substrate is conventional and also inherent in Bozada's, as generally known to one of ordinary skill in the art, the step is not explicitly recited in Bozada's.

- Especially regarding claims 5 and 16, Kobayashi et al. disclose a step of washing or cleaning an oxide surface to remove the native oxide, as recited in Col.6/II.27-47. which, when used in combination with Bozada's method, is conducted prior to conducting Bozada's thickness measurements, as understood by one of ordinary skill in the art.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to clean Bozada's oxide surface using Kobayashi's cleaning step prior to conducting thickness measurement, in order not to have the result of measurement falsified by the existence of a native oxide, as taught by Kobayashi et al. In Col.6/II.33-36, or at least, having a definite starting time point to take into account a re-growth of the natural oxide as a function of time, as implicated by Bozada et al. in Eq.(1).

- Especially regarding claims 12 and 16, the additional steps of "*determining whether the oxide film thickness falls in a desirable range*", and "*performing a succeeding step for manufacturing the semiconductor device when the oxide thickness falls in the desirable range*" are quite trivial for being inherent and/or conventional in every semiconductor manufacturing process (quality control).

17. Claims 2, 9, 13, and 20 are also rejected under 35 U.S.C. 103(a) as being unpatentable over Bozada et al. in view of Kobayashi et al..

Bozada et al. recite all the limitations of claims 2, 9, 13, and 20, except the recitation of correcting the thickness of the oxide film based on the "*exposure period*" to obtain a real thickness of the oxide film. However, given the knowledge of apparent thickness increase as shown in Bozada's Eq.(1), tracing back from the apparent thickness to its initial value using such a conventional logarithmic law is one of the most primitive and straightforward way quite obvious to one of ordinary skill in the art. This Official Notice previously taken by the Examiner is here supported by a large number of prior arts, e.g., (1) *Salmon et al.* (PTO-892) pg.272/Col.2, Eq.(2), referring to two references (Beaunier et al., 1984, and Dorlot et al. (1986), reciting that the logarithmic law is typical for the growth of thin oxide films, and (2) Schell et al., FZR Report 05/10/1999 (PTO-892), pg.2, Fig.2 + 2 lines below Fig.2

It would have been obvious to one of ordinary skill in the art at the time the invention was made to correct the thickness of the oxide film based on the "*exposure period*" according to Bozada's Eq.(1), since such a corrective action involves only routine skill in the art.

One would have been motivated to obtain the correct oxide thickness, since if this native oxide has grown too thick, it would hamper the function of a semiconductor device, as is conventionally understood in the art.

18. Insofar as the Examiner can ascertain beyond the above § 101 and § 112 rejections, claims 3, 10, 14, and 21 are also rejected under 35 U.S.C. 103(a) as being unpatentable over Bozada et al. in view of Kobayashi et al.

Bozada et al. as modified by Kobayashi et al. recite all the limitations of claims 3, 10, 14, and 21, except the recitation of correcting the thickness of the oxide film by means of a formula which is not invented by Applicant but is widely known in the art in various forms of empirical formulas, as admitted by Applicant himself on pg.15/II.17-20, and evidenced by Bozada et al. in Eq.(1).

This Official Notice previously taken by the Examiner is here supported by a large number of prior arts, e.g., (1) *Salmon et al.* (PTO-892) pg.272/Col.2, Eq.(2), shown in Fig.3 on page 273, referring to two references now provided per PTO-1449 (*Beaunier et al.*, 1984, recited in Eq.8.33 on page 234, and *Dorlot et al.* (1986), teaching that the logarithmic law is typical for the growth of thin oxide films, as recited in the 4th equation of Section II.1.B(a) on page 329 and Fig.II.5 on page 230; and further, (2) *Schell et al.*, FZR Report 05/10/1999 (PTO-892), pg.2, Fig.2 + 2 lines below Fig.2.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to correct the thickness of the oxide film according to any empirical formula recited in the prior arts mentioned above, since such a corrective action is the most simple and primitive method of correction that only involves routine skill in the art.

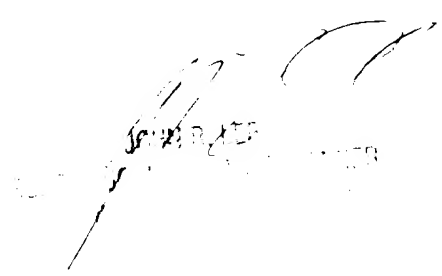
19. Regarding claims 6, 7, 17 and 18 Kobayashi et al. teach a method to clean an oxide surface using a solution containing HCl and hydrogen peroxide, thus simultaneously rendering obvious claims 6 & 17 (regarding a solution containing at least one of H₂SO₄ and HCl) as well as claims 7 & 18 (regarding a solution of either H₂SO₄ or HCl with hydrogen peroxide).

20. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Bernard E Souw whose telephone number is 703 305 0149. The examiner can normally be reached on Monday thru Friday, 9:00 am to 5:00 pm..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John R Lee can be reached on 703 308 4116. The fax phone numbers for the organization where this application or proceeding is assigned are 703 872 9318 for regular communications and 703 872 9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703 308 0956.

bes
June 18, 2003

A handwritten signature, possibly "Bernard E. Souw", is written over a rectangular stamp. The stamp contains the word "RECEIVED" in a bold, sans-serif font. The signature is written in dark ink and is somewhat stylized.